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A MOORING SYSTEM

TECHNICAL FIELD

The invention relates to a mooring system for floating structures, such as pontoons, platforms and the like. More specifically, the present invention relates to a mooring system that utilizes embeddable mooring piles and surrounding mooring dolphins, to which the floating structure can be secured. The system allows attaching floating structure to mooring piles which have lower fixed part that is driven into seabed and upper removable part which is bolted flange-to-flange to the lower fixed part.

Thus formed mooring pile is attached to the floating structure using adjustable mooring dolphin which allows acceptable construction eccentricity in the position of the mooring pile as compared to the design location.

BACKGROUND OF THE INVENTION

Floating structures subjected to wind, wave and currents are moored to prevent moving away from the designated site. Conventional mooring system utilises

- (a) Mooring ropes tied to shore side bollards with fenders to prevent floating structure hitting the landside;
- (b) Single continuous length mooring piles driven into seabed and mooring dolphin connecting the floating structure to the mooring piles.

Some patented designs use elastic ropes to connect the bottom of the floating structure to securing points installed on the seabed.

The drawbacks of existing methods are:

- (a) Mooring ropes tied to the shore side allow the floating structure to move in forward and aft direction. It also does not prevent the floating structure from rotational movements rolling and pitching.
- (b) Mooring piles overcome the above problems, but conventional single continuous length mooring piles cannot be removed from its location periodically if required to clear the location site of floating structure for other uses.

Drawback with patented mooring system using elastic ropes attached at the bottom of the floating structure to seabed is that it allows the floating structure to move to a limited extent in horizontal direction, allows it to rotate and move in vertical direction.

The present eliminates drawbacks associated with the prior art and provides a mooring system for attaching the floating structure to mooring piles and yet allowing part of mooring piles protruding above the seabed to be removed to prevent obstruction to boats or other activities in the vicinity. The system allows movement of the floating structure in vertical direction similar to conventional mooring pile system but with an advantage of freeing the site for other uses by removing the protruding part of the mooring piles.

More specifically, the present invention relates to:

- (a) Mooring piles comprising of two parts with the lower fixed part driven into seabed and upper removable part.
- (b) Flange bolted arrangement of the lower fixed part and upper removable part of the piles to form a complete mooring pile.



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(c) An adjustable mooring dolphin that can suit eccentricity in the location of the mooring pile due to construction tolerances.

Further objects of the invention will be apparent from review of the disclosure and description of the invention below.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be readily understood, one preferred embodiment of the invention will be described by way of example, with reference to the accompanying drawings wherein:

Figure 1 is elevation view showing lower fixed part and upper removable part of the mooring pile.

Figure 2 is elevation view of the flange joining the lower fixed part and upper removable part of the mooring pile.

Figure 3 is plan view of the flange joining the lower fixed part and upper removable part of the mooring pile.

Figure 4 is elevation view of the top of upper removable part of mooring pile.

Figure 5 is plan view the upper removable part of mooring pile.

Figure 6 is plan view of the adjustable mooring dolphin.

Figure 7 is elevation view of the adjustable mooring dolphin perpendicular to the floating structure.

Figure 8 is elevation view of the adjustable mooring dolphin parallel to the floating structure.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

The main requirement of the mooring unit is that it should constrain a floating structure, such as a barge, a platform, a pontoon and the like safely under the forecast natural conditions while keeping movement of the floating structure within safe limits that meet the requirements of its application. Typically, a fender-type mooring dolphin is used for protecting the floating structure from a fixed mooring pile. With the design of the present invention, a bracket is fitted on top and sides of the floating structure and welded thereto. One or more studs are secured to the brackets for engaging within elongated slots formed in the mooring dolphin securing arms. The slots allow for a limited adjustable movement of the mooring dolphins in relation to the floating structure so as to act against a reaction forces and adjust for the back-and-forth movements of the floating structure.

The mooring piles are located at pre-determined positions at site around the floating structure and the floating structure is attached to the mooring piles by adjustable mooring dolphins.

In order to remove the upper removable part of the mooring piles, the mooring dolphin is disconnected from the floating structure and sections of the adjustable mooring dolphins are removed completely. The fastening bolts joining the upper removable part of the mooring pile to the lower fixed part of the mooring piles are removed and the upper removable part is shifted, lifted and removed out of the water.

Turning to the drawings in more detail, Figure 1 shows the flanged joint between the lower fixed part and upper removable part of the mooring pile body. It also shows the lower fixed part of the mooring pile driven into seabed.

Figure 2 shows details of the flanged joint between the lower fixed part and upper removable part of the mooring pile including the pile dimensions and flange thickness. Plan view of the flange is shown in Figure 3 which shows positioning of the connecting bolts. Once the lower fixed part of the mooring pile is driven into seabed, the upper removable part of the mooring pile is required to be positioned to align the bolt holes to connect the two flanges by bolting. The lower pile body can be filled with sand, gravel and the like to increase its stability.

Figure 4 shows elevation view and Figure 5 shows plan view of the upper part of upper removable part of mooring piles. The gliding plates are provided on this part to provide full surface contact between mooring pile rollers. The top triangular plates with holes as shown in Figure 4 are used for lifting the upper removable part of the mooring pile for installation, adjustment and removal.

Figure 6 shows plan view of the adjustable mooring dolphin. The adjustable mooring dolphin connects the mooring pile to the floating structure. The adjustable dolphin is designed to accommodate the eccentricity in the position of mooring pile due to construction tolerances. This is achieved by designing the connection bolts such that the mooring dolphin can be moved both in directions perpendicular and parallel to the floating structure.

Figure 7 shows elevation view of the adjustable mooring dolphin perpendicular to the floating structure. The mooring dolphin is attached to the side of the floating structure by 6 studs, 3 on each side of the centre of the pile. The adjustable mooring dolphin has elongated slots to adjust the position of the mooring dolphin in a direction parallel to the floating structure.

Figure 8 shows elevation view of the adjustable mooring dolphin parallel to the floating structure. Part of the arms of the adjustable mooring dolphin extend over the deck of the floating structure and are secured to the supporting bracket structure welded to the deck. The extended arms of the mooring dolphin structure have elongated slots that engage the studs welded to the supporting bracket structure. This allows the mooring dolphin to be adjusted in a direction perpendicular to the side of the floating structure. While the mooring dolphin is so adjusted, the securing studs on the side of the floating structure are kept engaged.

Once both the connecting studs on the side and deck of the floating structure are engaged, securing nuts are installed and tightened to complete the installation of the adjustable mooring dolphins.

Although the above description and accompanying drawings relate to a specific preferred embodiment as presently contemplated by the inventor, it will be understood that the invention in its broad aspect includes mechanical and functional equivalents of the elements described and illustrated.

CLAIMS

We Claim:

1. A mooring system for a floating structure having a top surface and a sidewall, the system comprising:

at least one mooring pile having a lower portion capable of being embedded into a sea bed and an upper portion detachably securable to the lower portion, said lower portion extending from an underwater location; and

at least one mooring dolphin adjustably securable between the floating structure and the mooring pile, said at least one mooring dolphin being configured for a limited movement along vertical and horizontal axes in relation to the floating structure.

2. The system of Claim 1, wherein said at least one mooring dolphin is adjustably securable to said floating structure by a rigid securing assembly, while allowing the at least one mooring dolphin to be movable both in directions perpendicular and parallel to the floating structure.

3. The system of Claim 2, wherein said at least one mooring dolphin comprises rigid securing arms extending for engagement with the floating structure.

4. A mooring system for a floating structure having a top surface and a sidewall, the system comprising:

at least one mooring pile having a lower portion capable of being embedded into a sea bed and an upper portion detachably securable to the lower portion; and

at least one mooring dolphin securable between the floating structure and the mooring pile, said at least one mooring dolphin being adjustably securable to said floating structure, said at least one mooring dolphin comprising securing arms extending for engagement with the floating structure, and wherein said securing arms are provided with elongated slots for receiving securing pins attached to the top surface and the sidewall of the floating structure.

5. The system of Claim 4, wherein the securing pins are slidably received within said elongated slots to allow said at least one mooring dolphin a limited movement in relation to the floating structure in directions parallel and perpendicular a vertical axis of the floating structure.

6. The system of Claim 4, wherein securing brackets are secured to the top surface and the sidewall of the floating structure, and wherein said securing pins are secured to said securing brackets.
7. The system of Claim 1, wherein said lower portion comprises a lower pile body and a lower peripheral flange secured to exterior upper part of the lower pile body.
8. The system of Claim 7, wherein said upper portion comprises an upper pile body and an upper peripheral flange secured to exterior lower part of the upper pile body, said upper peripheral flange and said lower peripheral flange being capable of being aligned and secured to each other such that the upper pile body is detachably secured to the lower pile body about outer periphery thereof.
9. The system of Claim 7, wherein said lower peripheral flange and said upper peripheral each comprise a plurality of openings for receiving securing means therein and a stiffener plate for reinforcing attachment areas of the upper peripheral flange and the lower peripheral flange.
10. The system of Claim 7, wherein said upper pile body carries a gliding plate for facilitating full surface contact of the upper peripheral flange and the lower peripheral flange during alignment.
11. A mooring system for a floating structure having a top surface and a sidewall, the system comprising:
 - at least one mooring pile having a lower portion fixedly securable to a sea bed by embedment and an upper portion detachably securable to the lower portion in an underwater location upon demand; and
 - at least one mooring dolphin securable between the floating structure and the mooring pile, said mooring dolphin being adjustably securable in relation to said floating structure while allowing limited movement of the at least one mooring dolphin along vertical and horizontal axes in relation to the floating structure.
12. The system of Claim 11, further comprising means for adjustably securing said at least one dolphin in relation to said floating structure while allowing the at least one mooring dolphin to be movable both in directions perpendicular and parallel to the floating structure.
13. The system of Claim 12, wherein said securing means facilitate a limited movement of said at least one dolphin in directions substantially parallel and substantially perpendicular to a vertical axis of the floating structure.

14. A mooring system for a floating structure having a top surface and a sidewall, the system comprising:

at least one mooring pile having a lower portion fixedly securable to a sea bed by embedment and an upper portion detachably securable to the lower portion upon demand;

at least one mooring dolphin securable between the floating structure and the mooring pile, said mooring dolphin being adjustably positionable in relation to said floating structure;

a means for adjustably securing said at least one dolphin in relation to said floating structure so as to facilitate a limited movement of said at least one dolphin in directions substantially parallel and substantially perpendicular to a vertical axis of the floating structure, wherein said securing means comprises at least one securing bracket secured to the top surface of the floating structure and at least one securing bracket secured to a sidewall of the floating structure, a plurality of securing pins carried by each said at least one securing bracket, and securing arms attached to said at least one mooring dolphin, said securing arms being provided with elongated slots for receiving securing pins in a sliding engagement therein.

15. The system of Claim 11, wherein said lower portion comprises a lower pile body and a lower peripheral flange secured to exterior upper part of the lower pile body.

16. The system of Claim 15, wherein said upper portion comprises an upper pile body and an upper peripheral flange secured to exterior lower part of the upper pile body, said upper peripheral flange and said lower peripheral flange being capable of being aligned and secured to each other such that the upper pile body is detachably secured to the lower pile body about outer periphery thereof.

17. The system of Claim 16, wherein said lower peripheral flange and said upper peripheral each comprise a plurality of openings for receiving securing means therein and a stiffener plate for reinforcing attachment areas of the upper peripheral flange and the lower peripheral flange.

18. The system of Claim 16, wherein said upper pile body carries a gliding plate for facilitating full surface contact of the upper peripheral flange and the lower peripheral flange during alignment.